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Letter to the President

Dear Mr. President:

As it has done throughout its history, the National Institute of Building Sciences spent much of 2016 bringing diverse disciplines together to address a myriad of issues, from improving community resilience to helping building owners implement tools and technologies. The year proved to be a very interesting one for both the Institute and the nation's building community. This Annual Report highlights the Institute's activities throughout the year.

January began with Building Innovation 2016—The National Institute of Building Sciences Fourth Annual Conference and Expo, which brought together hundreds of building industry professionals to connect, collaborate and create solutions on Achieving a Resilient Future. Among the program tracks were several symposia focused on using incentives to advance resilience. Building on a 2015 report, Developing Pre-Disaster Resilience Based on Public and Private Incentivization, co-written by the Multihazard Mitigation Council (MMC) and the Council on Finance, Insurance and Real Estate (CFIRE), two of the symposia focused on using incentives from a variety of public and private-sector sources to encourage investment in hazard mitigation. The resulting discussion expanded after the conference into an addendum to the joint report. This conversation, as well as the Institute's expertise in resilience, also led to a number of opportunities.

Later in the spring, the MMC testified about incentivization before the U.S. House of Representatives Committee on Transportation and Infrastructure Subcommittee on Economic Development, Public Buildings and Emergency Management. The process of developing the oral and written testimony for the hearing helped the MMC further refine the goals and objectives of incentivization. Institute staff also spoke during the White House Conference on Resilient Building Codes, which provided a unique opportunity for diverse stakeholders to highlight the direct impact that building code development, adoption and administration has on the economic well-being of communities—particularly in the face of the emerging challenges posed by natural and man-made hazards. The MMC and CFIRE then participated in two other White House events: The White House Forum on Smart Finance for Disaster Resilience and the White House Roundtable on the Business Case for Climate Resilience, each of which advanced the conversation about the safety and security of our nation and our communities. We at the Institute are proud to have had the opportunity to assist in convening these important discussions, which brought together large segments of the building and emergency preparedness communities to discuss and formulate ideas on how to improve the nation's readiness.

Meanwhile, during the year, the Institute convened a group of experts across the building community to meet a different challenge: helping building owners to improve the process of constructing and operating buildings. Though many architectural, engineering and construction (AEC) firms are using building information modeling (BIM) to some degree, most building owners are not currently reaping the full benefits of this technology, which, when used correctly, can streamline the construction process and greatly improve facility maintenance and operations. Bringing together BIM experts and building owners, the Institute was able to develop the National BIM Guide for Owners in only eight months. The purpose of this guide is to equip owners with the knowledge necessary to utilize BIM to improve efficiencies during the construction, operation and ongoing maintenance of their facilities. Optimizing practices and procedures during all phases of a building's existence can improve productivity, make operations more efficient and even increase its longevity.

Extending the life of a building is particularly important, considering that less than one percent of the nation's building stock is replaced annually. Looking at ways to better utilize existing buildings, the National Council of Governments on Building Codes and Standards developed a white paper, The Role of Existing
Building Codes in Safely, Cost-Effectively Transforming the Nation's Building Stock.

Existing building codes offer jurisdictions the opportunity to keep their community's historic integrity while supporting economic viability. Existing building codes allow them to preserve their existing building stock while upgrading the safety of the structures without the undue burden of meeting a building code for a new building. This differentiation is an important element in providing local and state governments with the tools to transform their communities into more vibrant, resilient, high-performing and safe living environments.

Throughout its program areas, the Institute continues to focus on achieving high-performing buildings and supporting infrastructure as a priority. Whether looking at ways to improve building envelope performance or opportunities to incorporate off-site construction methods, the various Institute councils and committees, as outlined in this Annual Report, continued their work in 2016, engaging private-sector businesses and organizations, along with public entities, including state and local governments, to achieve their respective goals and objectives.

At the same time, using a collaborative approach, the Consultative Council provided a forum for the broader building community to discuss and evaluate ideas that have a wider impact across the many sectors of the building industry. In its report, Moving Forward: 2016 Findings and Recommendations from the Consultative Council (which can be found at the back of this Annual Report), the Consultative Council focused on two major industry concerns: developing a skilled workforce and the nation's water resources. These overarching priorities continue to impact the effectiveness of the nation's building industry.

This Annual Report provides insight into the work of the National Institute of Building Sciences and the concerns of the broader building community to achieve a more resilient, high-performing, secure built environment. We look forward to expanding on these ideas and highlighting new successes in the coming year.

Thank you, Mr. President, for your attention and consideration.

Sincerely,

Stephen T. Ayers, FAIA, LEED AP
Chairman, Board of Directors

Henry L. Green, Hon. AIA
President

About the Institute

The U.S. Congress established the National Institute of Building Sciences in 1974 to bring the public and private sectors together to address building science and technology-related issues to make buildings safer and better performing. For more than 40 years, the Institute has gathered the industry to tackle numerous challenges and find effective solutions. Today, the Institute continues to provide the opportunity for free and open discussion of issues and problems where there was once conflict and misunderstanding. It continues to assemble federal, state and local government agencies and representatives of the private sector for open working sessions that seek a consensus solution to problems of mutual concern. The Institute also works with federal agencies on projects related to the built environment to help achieve national goals.

The Institute’s 21-member Board of Directors is composed of 15 elected members and six members appointed by the President of the United States subject to the approval of the U.S. Senate. Headquartered in Washington, D.C., the Institute’s professional staff provides technical, managerial and administrative support for the Institute’s programs.
The National Institute of Building Sciences Board of Directors is a true representation of the public-private nature of the Institute's work. Comprised of 21 members, the Board consists of six members appointed by the President of the United States, with the advice and consent of the Senate, to represent the public interest. The remaining 15 members are elected and can represent either public interest or industry voices. The Board includes architects, builders, building owners, building standards developers, consumers, contractors, educators, fire safety professionals, insurance representatives, local agency officials, product manufacturers, professional engineers, state agency officials and others. However, the majority of Board members are required to come from the public interest category.

In 2016, the Board's Executive Team included Stephen T. Ayers, FAIA, LEED AP, the architect of the U.S. Capitol, as chair; Joseph Donovan, senior vice president at Beacon Capital Partners, as vice chair; Joy Marshall Ortiz, AIA, NCARB, executive vice president of The Marshall Group, as secretary; and Wally E. Bailey, director of development services for the City of Fort Smith, Arkansas, as treasurer.

Two new members were elected to the Board in 2016. Paul R. Bertram, Jr., FCSI, CDT, LEED AP BD+C, GGP, is founder of PRB Connect in Casselberry, Florida, and Anne M. Ellis, PE, FACI, FASCE, heads Anne Ellis, LLC, in McLean, Virginia. In addition, Cindy L. Davis, CBO, deputy director, Division of Building & Fire Regulation, Virginia Department of Housing and Community Development, was reelected to serve a second term.

Honored, upon completing their Board service at the end of 2015, were Dwight “Sonny” M. Richardson, Jr., owner of Richardson Home Builders, Inc. in Tuscaloosa, Alabama, and Steven R. Winkel, FAIA, PE, partner of The Preview Group, Inc., and manager of the firm's San Francisco Bay Area office.
The National Institute of Building Sciences relies on its more than 1,500 members to achieve its mission to improve the built environment by advancing building science and technology. Members contribute their experiences and expertise in their service on the Institute’s boards, councils, committees and projects. They volunteer their time to support the Institute in developing and implementing technical and procedural improvements for the industry. The Institute’s dedicated members represent all facets of the building community, including government agencies, design professionals, members of the construction industry, manufacturers, insurance representatives, educators, researchers and others. Their participation is crucial to the Institute’s ability to be the industry’s leader and advocate for the nation and the public interest. The Institute is grateful for their commitment. This Annual Report documents their dedication and accomplishments.
2016 Annual Institute Awards

Each year, the National Institute of Building Sciences recognizes individuals and organizations that have provided outstanding service to the Institute, the building community and the nation. The 2016 nominees include the committee responsible for creating the first building information modeling (BIM) guide for building owners, the founding chair of an Institute council, a White House policy director and a dedicated Institute leader.

The Institute Honor Award goes to an individual or organization that has made an exceptional contribution to the nation and the building community. The 2016 Honor Award recognizes the Institute’s National BIM Guide for Owners Committee for its work creating the National BIM Guide for Owners (NBGO), the first comprehensive, easy-to-follow guidance document to assist owners through the BIM process, standards and infrastructure required, and BIM execution.

Responding to the needs of increasingly savvy and project-involved building owners, a carefully balanced, integrated team—under the auspices of the Institute, the Building Owners and Managers Association (BOMA) International and ASHRAE—worked together to create the NBGO. Beginning in October 2015, the multidisciplinary team worked collaboratively to bring the 50-page guide from kick-off to final draft review in eight months.

The Institute Member Award goes to a member of the Institute or affiliate council who has made a substantial contribution in support of the mission, goals and objectives of the Institute. The 2016 Member Award recognizes Ryan E. Smith, associate professor and director of integrated technology and architecture, University of Utah, for his work and leadership on the Off-Site Construction Council (OSCC). As the founding chair of the OSCC, Smith’s vision and strategic planning fostered a productive start to the council, which kicked off in 2013. He has since helped to establish the OSCC as a valued research, education and outreach center for relevant and current information on off-site design and construction.

The Institute President’s Award is given to an individual or organization in recognition of extraordinary efforts to assist in advancing the mission of the Institute. The Honorable Alice C. Hill, special assistant to the president and senior director for resilience policy on the White House National Security Council during the Obama Administration is recognized for her work to improve the built environment and the safety of the nation’s communities.

Judge Hill served as the principal advisor on preparedness and resilience issues arising from climate change. In 2016, she provided leadership in promoting the advancement of building codes and resilience. The White House Conference on Resilient Building Codes offered a unique opportunity for diverse stakeholders to highlight the direct impact that building code development, adoption and administration have on the economic well-being of communities. Through her leadership, the White House also held forums on Smart Finance for Disaster Resilience and a National Preparedness Roundtable.

The Mortimer M. Marshall Lifetime Achievement Award, the Institute’s highest honor, goes to someone who has demonstrated a lifetime of dedication to the mission and goals of the Institute. Established in 2011 and named after the organization’s first member, this award is bestowed upon those who exhibit the passion upon which the Institute is founded. The 2016 Mortimer M. Marshall Lifetime Achievement Award goes to Gerald H. Jones, PE, in recognition of his extraordinary contributions to improving the seismic safety of the nation’s buildings and their occupants.

Jones worked from 1969 to 1983 for the City of Overland Park, Kansas, serving as the code administrator there before becoming the first director of code administration for Kansas City, Missouri, from 1983 to 1994. He was appointed in the 1970s to serve on the Advisory Committee for the National Earthquake Hazards Reduction Program by the Director of the Federal Emergency Management Agency (FEMA), and went on to chair the Institute’s Building Seismic Safety Council. As the chair of the Multihazard Mitigation Council, he was instrumental in the development of the 2005 study, Natural Hazard Mitigation Saves: An Independent Study to Assess the Future Savings from Mitigation Activities. Jones served on the Institute’s Board of Directors from 1993 until 1999, holding positions on the Executive Committee for all six years, including two years as chairman. His decades of participation have demonstrated a long commitment to the goals and mission of the Institute and exemplify the meaning behind the Marshall Award.

Earlier in 2016, the Institute issued a call to industry for nominations to identify potential award recipients. An Awards Committee reviewed the submissions and selected winners from the nominees, based on how their work meets the mission, objectives and goals of the Institute.

The Institute will celebrate its 2016 award winners at an Annual Reception and Awards Banquet, to be held January 11, 2017, during Building Innovation 2017: The National Institute of Building Sciences Annual Conference and Expo.

The Awards Committee will solicit nominations for 2017 awards in late spring of 2017, with nominations due in July.

Award Recipients

Institute Honor Award: National BIM Guide for Owners Committee

Institute Member Award: Ryan E. Smith

Institute President’s Award: Honorable Alice C. Hill

Lifetime Achievement Award: Gerald H. Jones, PE
INDUSTRY LEADERSHIP & ADVOCACY
Coordinating Council

The Coordinating Council serves as the place for representatives from each of the National Institute of Building Sciences’ standing councils and committees to come together to communicate about projects and activities and share ideas for potential collaboration. Consisting of each group’s leaders, the Coordinating Council convenes throughout the year in tangent with meetings of the Institute’s Board of Directors to update each other and the Institute Board about activities and concerns.

The Institute’s councils and committees consist of professionals from a wide range of fields. The Coordinating Council provides an assembly point for these experts from a variety of industries and backgrounds who may not have daily interactions in their careers, to meet and discuss mutual concerns, keep apprised of each other’s efforts and provide input on Institute projects. In 2016, the Coordinating Council served as the meeting ground for the Multihazard Mitigation Council and the Council on Finance, Insurance and Real Estate to discuss incentivization. The assembly of the group also triggered a discussion about the High Performance Building Council and whether other Institute programs and building industry organizations had taken up its mission.

Looking Ahead

In 2017, the Coordinating Council will meet throughout the year to discuss program activities and collaborate on mutual areas of interest.

Learn More

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Consultative Council

The Consultative Council released its 2015 findings and recommendations on January 14, 2016, during Building Innovation 2016: The Institute’s Annual Conference and Expo in Washington, D.C. The report, 2015 Moving Forward: Findings and Recommendations from the Consultative Council, concentrated on resilience and a changing climate; aligning government and business to achieve a cost-effective, high-performance built environment; and the buildings-related workforce and productivity. In June, staff highlighted the 2015 report during a presentation at a Congressional Briefing on Capitol Hill during High-Performance Building Week. Throughout the year, the Consultative Council worked extensively to develop content for the 2016 Moving Forward report, which is included in the Institute’s Annual Report to the President and the U.S. Congress. A summary of that report appears at the end of this Annual Report.

Looking Ahead

The Consultative Council will release its 2016 report in January during Building Innovation 2017. The 2016 Moving Forward report focuses on two key issues before the industry—developing a skilled workforce and the effective use of limited water resources. Staff plans to highlight the findings of that report in a presentation during High-Performance Building Week.

Learn More

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Council Leadership

Chair: Pete DeMarco, International Association of Plumbing and Mechanical Officials
Vice-Chair: Bob Horner, Illuminating Engineering Society
Secretary: Vicki Worden, Green Building Initiative
Low Vision Design Committee

The Low Vision Design Committee (LVDC) works to “address the needs of all occupants of the built environment, including those with low vision, through improvements in designs and operational procedures for new and existing facilities to enhance the function, safety and quality of life.” The LVDC strives to fulfill its mission by identifying relevant knowledge—and research gaps—and sharing that knowledge through the creation and refinement of design guidelines and building standards, including its seminal Design Guidelines for the Visual Environment. The LVDC ramped up outreach efforts throughout 2016, speaking nationally to conferences of the American Foundation for the Blind, American Institute of Architects (AIA) and Environments for Aging, as well as to local design and advocacy groups.

Looking Ahead
In 2017, the LVDC will continue to pursue conversion of its guideline into a national standard. The group also has been tapped to offer presentations at the Environments for Aging Expo & Conference in Las Vegas in February and the AIA National Convention in Orlando in April.

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Off-Site Construction Council

In March 2016, the Off-Site Construction Council (OSCC) released results from a survey conducted the previous year to gain an understanding of what software tools the industry is using for off-site construction projects. In September, the Council served as a co-host for the Off-Site Construction Expo, held in Washington, D.C. Throughout 2016, the OSCC hosted a series of webinars in collaboration with organizational partners as a means to widen understanding of the opportunities that the utilization of off-site construction technologies and techniques provides, as well as effective implementation.

Looking Ahead
The OSCC will summarize and expand the data compiled from the 2016 webinars for reference on the OSCC resource webpage, as well as host additional webinars in 2017. In January, the OSCC will release a case study of The Christ Hospital Joint and Spine Center expansion, which utilized bathroom pods, as a feature on both the WBDG Whole Building Design Guide® and as an Off-Site Construction Implementation Resource.

Learn More
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Council Leadership
Chair: Susan Klawans, Gilbane Building Company
Vice-Chair: Tom Hardiman, Modular Building Institute
Secretary: Laurie Robert, NRB
Institute Board Liaison: Cheryl R. English, FIES, LC, Acuity Brands

Committee Leadership
Chair: Edward L. Soenke, AIA, The Design Partnership
Vice Chair: Stuart Knoop, FAIA, OKKS Studios (retired)
Institute Board Liaison: Cheryl R. English, FIES, LC, Acuity Brands
National Council of Governments on Building Codes and Standards

In 2016, the National Council of Governments on Building Codes and Standards (NCGBCS) concentrated on expanding the information available about several important topics, including the use of existing building codes; the potential benefits of early code official involvement in projects; and the increased interest in shifting adoption cycles away from the traditional three-year cycle. Committees formed around these topics to gather information and begin developing white papers and other resources. In addition, the Council actively engaged in several White House events focused on advancing resilience, among them the May 10 White House Summit on Resilient Building Codes. A number of NCGBCS members also participated in interviews for a forthcoming Government Accountability Office study about incorporating future climate risk into codes and standards.

Looking Ahead

During Building Innovation 2017: The Institute’s Annual Conference & Expo, NCGBCS will release a white paper on the application of existing building codes and their role in cost-effectively protecting safety while encouraging rehabilitation and retrofit of underutilized buildings. The Council will continue developing white papers on early code official involvement in projects and the code development cycle. Additionally, NCGBCS will explore the role of code officials before, during and after disaster events.

Commercial Workforce Credentialing Council

In 2016, the National Institute of Building Sciences, through its Commercial Workforce Credentialing Council (CWCC), built the structure for a general certificate recognition program, which any credentialing body looking to achieve U.S. Department of Energy (DOE) recognition could use for its own certificate-level program based on a reduced-scope Better Buildings Workforce Guidelines (BBWG) Job Task Analysis (JTA). The CWCC also developed a reduced-scope JTA for the position of Building Operations Journeyworker (BOJ), based on the previously developed Building Operations Professional JTA. During the year, the Institute and DOE welcomed two more accredited BBWG jobs: Certified Energy Auditor, submitted by the Associated Energy Engineers, and Certified Commissioning Professional, submitted by the Building Commissioning Association. In addition, the Institute conducted outreach and support to generate interest in use of BBWG jobs in the public and private sectors. The CWCC also took steps in 2016 to expand beyond the energy sector into the facility security field by undertaking the development of accreditation requirements for an Explosive Effects (EE) Blast Design (BD) Professional JTA under a grant from the U.S. Department of Defense (DOD) Combating Counter-Terrorism Technical Support Office (CTTSO).

Looking Ahead

The CWCC will continue to support the BBWG program for DOE by doing outreach to employers, owners, operators, regulators and educators in the public and private sectors; working with credentialing bodies; and seeing more program certifications and certificates earning BBWG recognition. CWCC plans to work with community colleges to develop energy efficiency education programs that can lead to DOE-recognized certificates and support professional certifications. The CWCC also will continue its DoD CTTSO work to develop a JTA and accreditation scheme for EE/BP Professionals.
Science, Technology, Engineering and Mathematics Education Program

The science, technology, engineering and mathematics (STEM) Education Program, a joint initiative of the National Institute of Building Sciences (NIBS), Total Learning Research Institute (TLRI) and the National Aeronautics and Space Administration (NASA), reached several key milestones in 2016. The program launched a stand-alone curriculum, which teachers can use to introduce building systems; released the Building Sciences Career Center on the WBDG Whole Building Design Guide® portal that features information and interviews on multiple building-related disciplines; and organized about 20 building-related organizations into an informal building sciences pavilion at the 2016 USA Science & Engineering Festival. The program also hosted a booth at the Festival where Mars City Facility Operations (Ops) Challenge team members unveiled the first public showing of the virtual reality walk-through of the Mars base developed by KieranTimberlake. Additionally, representatives of the International Facilities Management Association continued work developing operations scenarios throughout the year.

Looking Ahead

The STEM Program will begin organizing the building industry to coordinate participation in a building sciences pavilion at the next USA Science & Engineering Festival in 2018. Team members will continue to develop the Mars City Facility Ops Challenge, integrating existing components into a web-based platform for utilization in classrooms and after-school programs. The program also will expand the Building Sciences Career Center to include additional disciplines and representative interviews.

Learn More

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STEM Leadership

Lead Organizations:
National Institute of Building Sciences
Total Learning Research Institute
National Aeronautics and Space Administration

Technical Support:
Alderson Engineering
Autodesk
Gilbane Building Company
International Facility Management Association
Jacobs Engineering
KieranTimberlake
Onuma Inc.
TMA Systems
Tipps Architecture

Platinum Plus Contributors
IFMA Foundation

Gold Contributors
International Association of Plumbing and Mechanical Officials
International Code Council

Silver Contributors
Acuity Brands
Beacon Capital
Daniel Steenstra
Gilbane Building Company
Joseph Romano
The Marshall Group
Mary Ryan
Tim Haahs

Bronze Contributors
Clancy & Theys Construction
Edd Soenke
Henry Green
Lenny Kolstad
Peter Smeallie
Rose Grant

Contributor
Bill Brodt
The Academy for Healthcare Infrastructure (AHI), a collaborative research program that brings together leading healthcare professionals to address industry challenges at a national level, focuses on improving the processes to create and maintain the complex built environment required to support America’s healthcare mission. In January, five AHI Interdisciplinary Research Teams presented white papers at the 2016 AHI Forum, held during Building Innovation 2016: The National Institute of Building Sciences Annual Conference and Expo. The topics explored were: Owner Organization for Successful Project Outcomes; Developing a Flexible Healthcare Infrastructure; Project Acceleration/Speed to Market Strategies; Defining the Next Generation's Focus; and Reducing Capital Costs. In June, AHI organized a call for presentations for the healthcare forum of Building Innovation 2017, under the theme of “Creating a High-Performing Environment for Healthcare.”

Looking Ahead
CFIRE and MMC will continue to refine the concept of incentivization in 2017 as the two councils identify a framework to develop resilience mortgages and other financing tools. CFIRE will work on additional white papers on topics related to financing sustainability and resilience efforts.

Academy for Healthcare Infrastructure

The Academy for Healthcare Infrastructure (AHI), a collaborative research program that brings together leading healthcare professionals to address industry challenges at a national level, focuses on improving the processes to create and maintain the complex built environment required to support America’s healthcare mission. In January, five AHI Interdisciplinary Research Teams presented white papers at the 2016 AHI Forum, held during Building Innovation 2016: The National Institute of Building Sciences Annual Conference and Expo. The topics explored were: Owner Organization for Successful Project Outcomes; Developing a Flexible Healthcare Infrastructure; Project Acceleration/Speed to Market Strategies; Defining the Next Generation's Focus; and Reducing Capital Costs. In June, AHI organized a call for presentations for the healthcare forum of Building Innovation 2017, under the theme of “Creating a High-Performing Environment for Healthcare.”

Looking Ahead
In 2017, members of the Academy will take part in a representative hearing, sponsored by the Institute, to gather feedback from the relevant stakeholders and produce a report detailing findings and recommendations for transmission to Congress; federal and state agencies; policymakers; codes and standards developers; healthcare providers; and other building industry stakeholders.

Learn More
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AHI Research Governors
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John A. Becker, U.S. Department of Defense Military Health System
Clayton Boenecke, U.S. Department of Defense Military Healthcare System
Michael H. Covert, CHI St. Luke’s Health System
Peter R. Dawson, AIA, Texas Children’s Hospital
Kip C. Edwards, Banner Health
Mark P. Ehret, AIA, INOVA Health System
Brian Holmes, Texas Health Resources
Walter B. Jones, Jr., MetroHealth
Tom Kinman, Children’s Medical Center
John Kouletsis, AIA, EDAC, Kaiser Foundation Health Plan, Inc.
Joanne Krause, Medical Facilities, U.S. Navy
Jeffrey W. Land, Dignity Health
JoAnn Magnatta, Main Line Health System
Robert F. McCoole, Ascension Health
Gregory Mehler, BJ’s Healthcare
Spencer Moore, MD Anderson Cancer Center
Scott Nelson, Advocate Health Care
Donald H. Orndorff, AIA, Kaiser Foundation Health Plan, Inc.
Judy Quasney, National Institutes of Health
Skip Smith, Catholic Health Initiatives
Dana E. Swenson, UMass Memorial
Denton Wilson, Methodist Health System
Stephen C. Wooldridge, MedStar Health
Don Wojtkowski, SSM Health

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Council Leadership
Chair: Lindene Patton, CoreLogic
Vice-Chair: Erin Rae Hoffer, Autodesk
Secretary: Michael Zimmer, Ohio University
Institute Board Liaison: Carl Hodde, Munich Re
Debra Ballen, Insurance Institute for Business & Home Safety
Andrew Dorchester, The Dorchester Group
James Finlay, SoundView Risk Advisors
Rose Grant, State Farm
Steve Orlowski, Building Owners and Managers Association
Leanne Tobias, Malachite
In 2016, the Building Seismic Safety Council (BSSC), under the sponsorship of the Federal Emergency Management Agency (FEMA), began the 2020 development cycle for the National Earthquake Hazards Reduction Program (NEHRP) Recommended Provisions for New Buildings and Other Structures. After assembling a new Provisions Update Committee (PUC), the BSSC held a workshop in March in Burlingame, California, to identify issues and recommendations, and to establish issue teams to prepare Provisions proposals. The PUC conducted three committee meetings and oversaw the work of nine issue teams during the year. In addition, the BSSC, under the sponsorship of FEMA and coordinated with the U.S. Geological Survey (USGS), assembled the new Project 17 Committee (P17C) to address development of the next generation of seismic design value maps. The P17C conducted three meetings and oversaw efforts of five work groups. As a follow-up to the 2015 NEHRP Provisions, the BSSC completed training materials and presented six webinars in 2016. The BSSC Code Resource Support Committee (CRSC) monitored the code change process of the International Building Code, International Existing Building Code and International Residential Code to ensure the codes include seismic design guidance from the 2015 Provisions. The CRSC also testified at the International Code Council’s Committee Action Hearings in April and Public Comment Hearings in October.

Looking Ahead
In 2017, the BSSC will conduct a new series of webinars based on the 2015 Provisions. The PUC will ballot the current American Society of Civil Engineers (ASCE)/Structural Engineering Institute (SEI) 7-16 standard for use as the primary reference for the 2020 Provisions and the issue teams will begin drafting proposals. The P17C will conduct a workshop in April to solicit input from the seismic community for the work groups. In September, the BSSC will conduct a session at the 2017 Structural Engineers Association of California (SEAOC) Convention to present progress on the 2020 Provisions.

Scientific Resolution Panel
In 2016, the National Institute of Building Sciences continued its Scientific Resolution Panel (SRP) work with the Federal Emergency Management Agency (FEMA). During the year, the Institute increased its database of coastal storm and hydraulic engineer experts by 19%. The Institute convened an Independent Panel to review technical data submitted by a Region II community and presented the final report to FEMA in October of 2016.

Looking Ahead
In 2017, the Institute will continue to convene SRPs on an as-needed basis to address community and/or FEMA concerns.
Multihazard Mitigation Council

In January 2016, experts from real estate, business, finance, insurance, the utility sector and government participated in two symposia, “Realizing Resilience: Incentives for Owners and Operators” and “Realizing Resilience: Incentives for Local Leaders and Lifelines,” during Building Innovation 2016: The National Institute of Building Sciences Annual Conference. This stakeholder discussion centered on the white paper, Developing Pre-Disaster Resilience Based on Public and Private Incentivization, co-published by the Multihazard Mitigation Council (MMC) and Council on Finance, Insurance and Real Estate (CFIRE), which focused on a new “market” approach to achieve resilience. In April, the Journal of the National Institute of Building Sciences (JNIBS) summarized the proceedings in Realizing Resilience through Incentives: Results from the Institute’s 2016 Symposium. In May, MMC testified on incentivization before a U.S. House of Representatives Committee on Transportation and Infrastructure Subcommittee on Economic Development, Public Buildings and Emergency Management, which helped MMC refine the concept further. In August, MMC participated in the White House Forum on Smart Finance for Disaster Resilience. In September, MMC issued An Addendum to the White Paper for Developing Pre-Disaster Resilience Based on Public and Private Incentivization, which provided additional examples; proposed layered approaches; and defined a resilience economy. MMC and CFIRE also prepared the summary, An Introduction to Pre-Disaster Resilience Based on Public and Private Incentivization. In September, MMC and CFIRE briefed Congressional staff and representatives of the Congressional Research Service, Small Business Administration, National Emergency Management Association and the private sector, and shared Recommendations for Incentivizing Resilience, for the federal government. In October, JNIBS ran Widespread Support for Incentivizing Disaster Resilience. In November, MMC and CFIRE presented at the White House Roundtable on the Business Case for Climate Resilience. The White House report, Standards and Finance to Support Community Resilience, released in December, highlighted MMC and CFIRE’s efforts and announced funding for MMC to update its 2005 Mitigation Saves study. During the year, the MMC presented its Mitigation Saves Version 2 proposal to the Office of Management and Budget, which arranged financial support from the Federal Emergency Management Agency. The Insurance Institute for Business and Home Safety, the International Code Council and The American Institute of Architects also have committed support to the project. (See the section on Mitigation Saves Version 2 for more information.)

Looking Ahead

In 2017, the MMC will work with the housing, mortgage and insurance communities on a framework for a resilience mortgage; update the summarized version of the incentivization white paper; and present on incentivization and Mitigation Saves Version 2 at Building Innovation 2017.

SAFETY Act for Commercial Facilities

In 2016, under contract with the U.S. Department of Homeland Security (DHS) Science & Technology (S&T) Office of Safety Act Implementation (OSAI), the National Institute of Building Sciences completed its work to develop a process for conducting assessments of facilities to meet the Support Anti-terrorism by Fostering Effective Technologies Act of 2002 (SAFETY Act) application requirements. The Best Practices for Anti-Terrorism Security (BPATS) Tool for commercial facilities and accompanying training program is now complete and ready to help assessors and building owners conduct facility assessments when applying for SAFETY Act coverage. Commercial facility owners can get coverage under the SAFETY Act if they demonstrate compliance with these best practices, thereby limiting exposure if the building is subject to a terrorist attack.

Looking Ahead

In 2017, the Institute anticipates working with DHS to release the BPATS Tool and provide training in its use for commercial facility owners and assessors.

Learn More

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Mitigation Saves Version 2

In 2005, the National Institute of Building Sciences Multihazard Mitigation Council (MMC) completed *Natural Hazard Mitigation Saves: An Independent Study to Assess the Future Savings from Mitigation Activities* (MSv1), funded by the Federal Emergency Management Agency (FEMA) to quantify future savings from that agency’s natural hazard mitigation efforts. The study, which found, “For every public dollar spent on mitigation, there is a savings of $4 to society,” indicated that FEMA’s natural hazard grant mitigation programs had been extremely effective in reducing future losses from earthquake, wind and flood. In late 2016, more than a decade after the MSv1 report was released, the MMC, with the financial support of FEMA, the International Code Council (ICC), Insurance Institute for Business & Home Safety (IBHS) and The American Institute of Architects (AIA), began *Mitigation Saves version 2* (MSv2), to look at the cost effectiveness of disaster mitigation efforts, but with a much broader scope than the original effort. The new study will deliver the benefit-cost data for a variety of stakeholders. In addition to FEMA’s mitigation grant programs, the project team will evaluate several other federal agency programs, as well as specific mitigation strategies. Since the project began in late 2016, the project team has gathered data from FEMA, the Small Business Administration, the Economic Development Administration (EDA) and the U.S. Department of Housing and Urban Development. The team also developed the methodology for the earthquake analysis, which has been reviewed by the oversight committee.

Looking Ahead

In 2017, the project team will develop methodologies for wind, flood and wildfire analysis. The oversight committee and key stakeholders from insurance; finance; federal, state and local government; building-related associations; and hazards-related organizations will meet at a workshop in February to review benefit-cost mitigation analysis for each of the four perils. The project team will submit the project results and preliminary findings to the oversight committee in late May for review, and in August, the oversight committee and stakeholder representatives will review a draft of the final report for two of the seven project modules. The project team will deliver the final report for those modules to FEMA in September for publication.

Learn More

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Integrated Rapid Visual Screening

In 2016, the National Institute of Building Sciences continued to support the Integrated Rapid Visual Screening (IRVS) tool for the U.S. Department of Homeland Security (DHS) Science and Technology Directorate (S&T), as it has done since 2011. In that role, the Institute provides the IRVS Interagency Security Commission (ISC) version to federal agencies upon request and related support as needed. The Institute also continued its work with DHS S&T to develop a long-term plan to make all versions of IRVS, including the IRVS for Buildings, Mass Transit Stations and Tunnels; the IRVS ISC; and the IRVS for Schools, available to government and private-sector users.

Looking Ahead

The Institute will continue to work with DHS on the long-term plan for IRVS. Once it is in place, the Institute will form user groups to provide support and continue ongoing development.
The Building Enclosure Technology and Environment Council (BETEC) encourages optimum energy use of buildings through a better understanding of how building components interact with each other and with the environment. In 2016, BETEC members continued to work together to share knowledge of existing and new technologies and practices, and to integrate technical programs on building safety, durability, resilience and occupant comfort with the thermal performance of building envelopes. Kicking off the year, the BETEC Education Committee hosted a workshop on the state of building science education during Building Innovation 2016: The Institute’s Annual Conference & Expo in January. Under the aegis of BETEC, the Building Enclosure Councils (BECs), a joint venture between The American Institute of Architects and the National Institute of Building Sciences, host almost 4,000 members in 33 cities across the country. With BETEC as a sponsor and BEC-Austin as a host, the BECs presented the BEC National Conference on May 5, in Austin, Texas, to some 200 participants. BETEC and the BECs co-sponsored the Buildings XIII Conference, sponsored by the U.S. Department of Energy and Oak Ridge National Laboratory, December 5-8 in Clearwater, Florida. BETEC also published two building enclosure design-focused issues of the Journal of the National Institute of Building Sciences (JNIBS), the first in February, with the theme “Energy-Efficient Building Enclosures” and the second, “Thinking Outside the Box: Solving Building Enclosure Challenges,” in August.

Looking Ahead

In 2017, BETEC will pick up the pace on planning for the fifth BEST Building Enclosure Science and Technology Conference™ (BEST5), slated for April 2018 in Philadelphia. 2017 also will see the development and launch of the pilot for the certificate program on building enclosure commissioning. In addition, BETEC members will update sections of the Building Envelope Design Guide, part of the Institute’s WBDG Whole Building Design Guide® website. BECs will hold a symposium/annual meeting in Detroit, hosted by BEC-Detroit, during the year.
U.S. Department of Defense – Defense Health Agency

The National Institute of Building Sciences continued its work on task orders with the U.S. Department of Defense (DOD) Defense Health Agency (DHA) in 2016. The Institute also provided support of facility budget cost models and real property technical expertise; was instrumental in providing support for the Capital Improvement Decision Model (CIDM) 4.2 process; and gave guidance in the areas of project management, execution, including Military Construction (MILCON), sustainment, restoration and modernization, which led to strategic recommendations for future policy adoption.

Looking Ahead

In 2017, the Institute will continue working on newly awarded task orders that facilitate DHA’s initiative to share data with other federal agencies and consider life-cycle management principles in sustaining and maintaining medical facilities. The Institute will begin a DHA Commissioning pilot program in mid-year 2017.

Advancing Energy and Water Efficiency in Stadiums and Arenas

In 2016, a project team of representatives from the National Institute of Building Sciences and the Green Sports Alliance began working with the U.S. Department of Energy on a project that looks at reducing water and energy use in some of the nation’s largest facilities: stadiums and arenas. To effectively implement energy- and water-saving measures in stadiums and arenas requires an understanding of the roles and responsibilities of the numerous stakeholders involved in the planning, design, construction and operation of these venues. To build this understanding, the team undertook a literature review; conducted workshops and webinars; launched an industry survey; and interviewed representatives from across the sports industry. More than 125 industry representatives participated in these activities, and an additional 20,000 stakeholders received information on the project.

Looking Ahead

The project team plans to issue the final project report at the Stadium Managers Association Symposium in February 2017. The report will outline the activities owners and operators are already undertaking; the challenges to widespread implementation of energy- and water-saving strategies; and the potential avenues to overcome these challenges. Following release of the report and a webinar of findings and recommendations, the project team will evaluate the next steps to engage and empower the industry to achieve the potential results the report identifies.
In January, the Sustainable Buildings Industry Council (SBIC) hosted its annual awards luncheon during Building Innovation 2016: The National Institute of Building Sciences Fourth Annual Conference and Expo. The Beyond Green™ High Performance Building and Community Awards recognize inspiring projects, initiatives and innovations. The 2015 Honor Award, SBIC’s top prize in the High-Performance Buildings Category, went to the United Nations Headquarters in New York, New York, for its sustainable renovation project. The 2015 Beyond Green™ Award Jury also recognized two recipients to receive Merit Awards. The Award of Merit in Category A: High-Performance Buildings went to the Center for Sustainable Landscapes at the Phipps Conservatory and Botanical Gardens in Pittsburgh, Pennsylvania. The Award of Merit in Category C: High-Performance Initiatives went to the Efficient Homes Initiative of the Northwest Energy Efficiency Alliance (NEEA) and its utility partners. During the 2015 Beyond Green™ Awards Luncheon, each of the recipients gave slide presentations highlighting their award-winning topics. The winners are featured as case studies on the WBDG Whole Building Design Guide®.

Looking Ahead
The SBIC will host its 2016 Beyond Green™ Awards Luncheon in January 2017 and issue a call for entries in the summer for the 2017 Beyond Green High-Performance Building and Community Awards. SBIC will develop case studies of the winners for inclusion on the WBDG.
VA Facility Management Programs

In 2016, the National Institute of Building Sciences continued to work with the U.S. Department of Veterans Affairs (VA) to improve acquisition, development and life-cycle management of the federal agency’s real property portfolio. Among its projects for the VA Office of Construction and Facility Management (CFM), the Institute worked on a VA Healing Environments Design Guide; Physical Security and Resiliency Design Manual; Physical Security Design Manual for Mission Critical Facilities; Physical Security Design Manual for Life-Safety Protected Facilities; a VHA staffing study for VA Medical Center engineering staff; development of Version 2 of the VA BIM Guide; and the next edition of A/E Submission Requirements for VA Medical Center Major New Facilities, Additions & Renovations Program Guide PG 18-15 Volume B. The Institute also managed the training sessions for the healthcare facility space and equipment planning system (SEPS), jointly owned and maintained by VA and the U.S. Department of Defense (DOD) Defense Health Agency (DHA), as well as the next phase of the SEPS2BIM initiative.

Looking Ahead

In 2017, the Institute will complete its contract with CFM on a historic preservation reuse initiative, including development of an assessment tool to evaluate historic buildings for adaptive reuse; investigation of best practices for the reuse of historically significant buildings for healthcare-related services; and prototype designs for VA historic building configurations for clinical, administrative and residential healthcare services.

High Performance Building Council

In September 2016, a decade after the National Institute of Building Sciences established the High Performance Building Council (HPBC), the HPBC chair and staff began a discussion with the Institute Board about sunsetting the program. The Institute founded the HPBC in 2007 in response to a request from the U.S. Secretary of Energy to assess the existing voluntary standards and rating systems that defined high-performance buildings at the time. The HPBC delivered the resulting report, Assessment to the U.S. Congress and the U.S. Department of Energy on High Performance Buildings, to the Department of Energy (DOE) in 2008. In the years since, the HPBC worked on the Owners Performance Requirements Tool (OPR) and related report for the U.S. Department of Homeland Security (DHS) Science & Technology Directorate (S&T); the report, A Common Definition for Zero Energy Buildings, for DOE; and the National Performance Based Design Guide based on research and development supported by DHS S&T and the U.S. General Services Administration (GSA) Public Buildings Service. The HPBC mission has since permeated into virtually all of the Institute’s other councils and committees; high performance is a primary theme of the Institute’s conferences; and the Institute’s Consultative Council prioritizes high-performance buildings in its recommendations to the president of the United States and Congress.

Looking Ahead

The Institute Board of Directors will make a decision regarding the HPBC at its January 2017 meeting.
Commissioning Industry Leaders Council

Over the course of 2016, the Commissioning Industry Leadership Council (CxILC) members continued to work within their respective certification programs to achieve recognition by the U.S. Department of Energy (DOE) Better Buildings Workforce Guidelines program.

Looking Ahead
In 2017, the CxILC will continue to share best practices and support the development of resources to support widespread utilization of commissioning as a means to advance building performance and the realization of owner project objectives.

National Mechanical Insulation Committee

The National Mechanical Insulation Committee (NMIC) for Building and Industrial Applications continued its work in 2016, updating several pages of the Mechanical Insulation Design Guide (MIDG) hosted on the WBDG Whole Building Design Guide® web portal. The Committee is chaired by the National Insulation Association (NIA) and the NIA's Foundation for Education, Training and Industry Advancement funds many of its activities.

Looking Ahead
In 2017, the NMIC will continue to update the MIDG and provide educational resources on mechanical insulation.

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INFORMATION RESOURCES & TECHNOLOGIES
Building Research Information Knowledgebase

The Building Research Information Knowledgebase (BRIK), a joint project of the National Institute of Building Sciences (NIBS) and The American Institute of Architects (AIA), continued to acquire new partners in 2016 and extend its database for the purpose of offering professionally reviewed building-related research to practitioners. During the year, BRIK continued to assemble a “database within a database” for the U.S. Department of Defense (DOD) Defense Health Agency (DHA), offering research reflecting a specified mandate for topics pertinent to the agency. The addition of the EBSCO search services permitted BRIK users access to tens of thousands of abstracts in three databases: Arts and Architecture, the Avery Index to Architectural Periodicals and EBSCO’s Sustainability Reference Center. In April, staff hosted a booth at the AIA National Convention in Atlanta to showcase BRIK and demonstrate how to use it.

Looking Ahead

2017 will be the “Year of Marketing” for BRIK, with an extensive effort, including print and digital advertising, designed to make AIA members aware of the value of research to their practices. In addition, NIBS will market the EBSCO services extension as an exclusive benefit of NIBS membership.

Learn More

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A photo from “Best Practices for Architectural Coatings,” by Elizabeth A. Hnatiw, AIA, a research article from one of BRIK’s newest partners, Hoffmann Architects.

National Clearinghouse for Educational Facilities

Throughout 2016, the National Clearinghouse for Educational Facilities (NCEF) website, at www.ncef.org, functioned solely as an archival site due to lack of funding. Despite its archival status, NCEF remains a primary resource of information on constructing and maintaining educational facilities. More than 250,000 visitors visited the site, viewing nearly half a million pages over the course of the year. The Institute worked to maintain the Clearinghouse for the architects; engineers; planners; builders; state and local officials; administrators; and teachers who still use the site. To increase its usability and compatibility with other Institute resources, including the WBDG Whole Building Design Guide® and the Building Research Information Knowledgebase (BRIK), NCEF’s content was migrated into Drupal, a new and powerful content management system. The addition of advertising to the website pages during 2016 was not able to generate enough income to support fresh content being posted regularly on NCEF.

Looking Ahead

In 2017, the material housed in the NCEF website will be evaluated for inclusion in other Institute venues.

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Each year, millions of users visit the WBDG Whole Building Design Guide® after searching the internet for relevant building-related information that is difficult or impossible to find elsewhere. In 2016, the WBDG set a record for the highest number of visitors yet—6.8 million people came to the site and downloaded a total of 45 million documents.

The various committees responsible for maintaining the WBDG updated six major sections and three resource pages during the year and added three new resource pages and six new case studies. WBDG now offers more than 80 online WBDG and Federal Energy Management Program (FEMP) courses, an addition of eight new FEMP courses in 2016. Institute staff members worked to promote the use of WBDG through presentations to multiple audiences, including the National Facilities Management and Technology Conference (NFMT) in Baltimore, Maryland; the High Performance Buildings & Workplaces (HPB+W) Conference in Austin, Texas; a regular “What’s on WBDG” contribution to the Institute’s monthly newsletter, Building Sciences; and an article in the Journal of the National Institute of Building Sciences (JNIBS). In November, after nearly a yearlong effort, staff launched the new WBDG website. Many of the site’s regular visitors immediately praised the new design, features and functionality.

Looking Ahead

WBDG will add new case studies and resource pages, as well as more than 10 new FEMP online courses in 2017. Staff, with the support of various committee members, is planning to update six major WBDG sections. Staff will continue to promote WBDG via live presentations at meetings and conferences, and via Twitter, LinkedIn and other social media, blogs and podcasts.

GSA Central Facility Data Architecture and Taxonomy

In 2016, the National Institute of Building Sciences continued its work with the U.S. General Services Administration (GSA) Public Buildings Service (PBS) Office of Public Buildings Information Technology Services (PB-ITS) to evaluate use cases for GSA processes. The Institute delivered its final report, which analyzed the requirements for facility management, emergency management, building performance and energy management to determine building information modeling (BIM) requirements to support GSA systems and procedures. The Institute also delivered an accompanying industry foundation class (IFC)-based model view definition (MVD) to identify open standards-based exchange requirements between BIM applications and GSA systems.

Looking Ahead

In 2017, the Institute will work with GSA to elaborate the requirements for comparing GSA’s building energy performance as modeled with its energy performance as measured. Using the expanded energy requirement specification and the previously developed facility management requirements, the Institute will work with GSA, its design consultants and software and system providers to deploy the exchange specifications to allow GSA to further integrate data from BIM with its internal systems to improve facility operations.

Learn More

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In 2016, the buildingSMART alliance® continued putting its new organizational structure into place, establishing leadership for its subcommittees and task groups and creating operational guidelines. During the year, the Thought Leadership Subcommittee advanced the Alliance's mission by presenting at several webinars and industry events. The Communications Subcommittee expanded its use of social media to reach a broader audience. In addition, the buildingSMART alliance continued activities relating to its computer-aided design (CAD), building information modeling (BIM) and information exchange standards efforts (see the sections on the United States National CAD Standard®, National BIM Standard–United States® and Information Exchanges for an expanded update). Several Alliance members served on the multidisciplinary team tasked with developing the National BIM Guide for Owners and the full Alliance membership participated in the review.

Looking Ahead
The Alliance will begin planning for the next standards development cycles of the NCS and the NBIMS-US™; initiate an overall business process map to identify needed information standards; launch a practice innovation forum to evolve ideas into approved standards; and initiate new educational initiatives that include establishing a professional education clearinghouse for BIM education in the United States.

In 2016, the marketing team for the nation's computer-aided design (CAD) standard, the United States National CAD Standard® (NCS) Version 6, continued to promote the new standard. The NCS Marketing Team, which consists of the NCS contributing organizations, The American Institute of Architects (AIA), Construction Specifications Institute (CSI) and National Institute of Building Sciences (NIBS), advertised in both in-house publications and industry periodicals. During the year, the National Institute of Building Sciences buildingSMART alliance®, which through a steering committee oversees development of the NCS, began the process of redesigning the voting tool to be ready in time for the NCS Version 7 standard development cycle. In May, the NCS Steering Committee held its first educational webinar. The next development cycle is expected to begin in the fall of 2017.

Looking Ahead
In 2017, the NCS Steering Committee will hold its second webinar and continue creating other education programs and events to support adoption and implementation of the standard.
National BIM Standard-United States®

Following the release of a new edition of the nation’s building information modeling (BIM) standard, the National BIM Standard-United States® (NBIMS-US™) Version 3 (V3), in 2015, the buildingSMART alliance® recorded more than 27,000 downloads from over 130 countries in 2016. A consensus-based standard, the NBIMS-US™ references existing standards, documents information exchanges and delivers best business practices for the entire built environment. With open BIM standards, the industry can build detailed models; deliver accurate products that can be used during commissioning and operation; and deliver high-performance, carbon-neutral, zero-energy buildings.

Looking Ahead
In 2017, the buildingSMART alliance® Information Standards Subcommittee will initiate a business process model to map out what was accomplished thus far with NBIMS-US™, to identify and prioritize the BIM standards work that still needs to be done.

National BIM Guide for Owners

In 2016, the National Institute of Building Sciences published a new guide to help building owners and their design teams use building information modeling (BIM) during a facility’s planning, design, construction and operations processes and to better support owners’ performance requirements. Created under the auspices of the Institute, Building Owners and Managers Association International (BOMA) and ASHRAE, the National BIM Guide for Owners (NBGO) provides information in three major areas: process; infrastructure and standards; and the Project Execution Plan. A multidisciplinary team of experts from various stakeholder groups designed the 36-page NBGO, which underwent an extensive public review and is now available on the Institute’s website.

Looking Ahead
In 2017, the Institute will look for opportunities to develop the NBGO into an industry standard.

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Facility Maintenance and Operations Committee

In March, the Facility Maintenance and Operations Committee (FMOC) held a committee meeting during the 2016 National Facilities Management and Technology Conference & Exposition (NFMT) in Baltimore, Maryland. In addition, FMOC staff and members hosted three sessions during the conference, the first on issues facing facility managers today and in the future; the second on capturing design and construction information for building operations and facility management (FM); and the third on FM resources available in the WBDG Whole Building Design Guide®. Throughout the year, FMOC continued its quest to extend the Construction to Operations Building information exchange (COBie) to building product manufacturers by reaching out to potential partners and volunteers to develop the templates that define product parameters and values. The U.S. Department of Defense (DOD) Unified Facilities Guide Specifications (UFGS) were identified as primary candidates to mark up the table and product information. At its summer virtual meeting, the committee identified two topics to pursue in the coming months: maintenance failure mode effects analysis for facilities equipment and facility transition planning.

Looking Ahead

The FMOC will convene in January at Building Innovation 2017 in Washington, D.C., and in March at NFMT 2017 in Baltimore. In addition, FMOC members will convene in the spring to update the WBDG Facilities Operations & Maintenance section. The FMOC plans to form new subcommittees to address operations and maintenance topics during the year.

Information Exchanges

Following the release of the latest version of the Construction to Operations Building information exchange (COBie), COBie Version 2.4 and seven other information exchanges (IEs) were incorporated in the new version of the nation’s building information modeling (BIM) standard, the National BIM Standard-United States® (NBIMS-US™) Version 3 (V3). In 2016, the buildingSMART alliance® (bSa) COBie Task Group (CTG), the group exercising stewardship of the COBie standard, convened on a monthly basis to review, discuss and consider industry proposals to amend the latest edition of the standard. The task group also worked to promote and support wider adoption of COBie. During the year, the CTG presented at public events around the country, including the National Facilities Management and Technology Conference & Exposition (NFMT) in Baltimore, Maryland, in March; the International Facility Management Association (IFMA) Facility Fusion 2016 in Indianapolis, Indiana, in April; and at Autodesk University 2016 in Las Vegas, Nevada, in November.

Looking Ahead

In 2017, the CTG plans to submit COBie revisions to the NBIMS-US™ when the next standards development cycle begins. Additionally, the newly formed bSa Information Standards Subcommittee will start work on a business process model to map out IEs over the course of a medium-sized design and construction project to help prioritize the future bSa BIM-standard efforts.
FHWA Advancement of Bridge Information Modeling Standards

In 2016, the National Institute of Building Sciences completed its work on the Federal Highway Administration (FHWA) Advancement of Bridge Information Modeling (BrIM) Standards Project. The project team issued a comprehensive four-volume report that covers the bridge life-cycle process and potential bridge modeling schema based on analyses of two common types of bridges: a four-span steel girder and five-span reinforced concrete box beam. The team also released an accompanying exchange specification using the industry foundation class (IFC) schema to develop a model view definition (MVD) for the Design to Construction Contract exchange. Access to the Report and the MVD are available from the Institute website.

Looking Ahead

In 2017, the Institute anticipates working with FHWA; the American Association of State Highway and Transportation Officials (AASHTO) Subcommittee on Bridges and Structures Committee T-19 Computers; state departments of transportation; and technology companies to implement the recommendations in the report and MVD to advance a common and standardized methodology for defining BrIM data.

ProjNet™

ProjNet™ helps owners manage each step in a facility design review and acquisition process to foster authorized stakeholder collaboration and improve overall project management. In 2016, the National Institute of Building Sciences continued to manage this secure, integrated, internet-based suite of construction design and communication tools, providing ProjNet™ sales support and overseeing hardware, software, networking, information assurance, programming and user support activities. During the year, the ProjNet™ team continued the modernization of the ProjNet™ suite and worked on the U.S. Army Corps of Engineers (USACE) Certification and Accreditation (C&A) of the ProjNet.org system.

Looking Ahead:

In 2017, the ProjNet™ team will beta test the implementation of the ProjNet-DrChecks™ application. The team also will work on the U.S. Department of State C&A; provide continued support to its federal, institutional and commercial customers; and promote the ProjNet™ suite of tools to expand its user base.
buildingSMART International Product Room anduildingSMART Data Dictionary Management

In 2016, the National Institute of Building Sciences continued to provide leadership for the buildingSMART International (bSI) Product Room and support the buildingSMART Data Dictionary (bSDD) operation. Participation in the Product Room grew in response to national programs in European and Asian countries developing common object libraries to support building information modeling (BIM) programs around the world. Efforts focused on developing the model to access the shared terminology service. A common framework and process for product data templates integrated with the bSI industry foundation classes (IFC), and model view definition (MVD) standards are being pursued in response to user requirements for a common, open standard-based approach to connecting product data to building models.

Looking Ahead
The Institute will continue to support the bSI Product Room and the bSDD programs in 2017, as bSI deploys procedures for harmonizing terminology used in models in applications and programs around the world.

U.S. Department of State Overseas Building Office
BIM Program Development

In 2016, the National Institute of Building Sciences worked with the U.S Department of State Overseas Building Office (OBO) to support the office's goals to improve the use of building information modeling (BIM) in its overseas building design, construction and facilities program. The OBO BIM Program mission is to establish a roadmap that enables decision-makers access to high-quality data to provide an accurate account of facility information and to better manage OBO's worldwide portfolio. The Institute's project team is helping OBO to optimize the use of BIM data and create integrated workflows with the information systems to improve the quality and consistency of project data being delivered to current and future OBO systems.

Looking Ahead
In 2017, the Institute will complete the Phase 1 Roadmap report, which covers integration of BIM with OBO systems and processes, and provides recommendations on guidelines and contract language for aligning design and construction projects with BIM Program goals. The Institute anticipates continuing to work with OBO to complete the Roadmap and support the implementation of recommendations throughout 2017.
Building Innovation 2016—The National Institute of Building Sciences Fourth Annual Conference and Expo brought together hundreds of building industry professionals to connect, collaborate and create solutions on Achieving a Resilient Future. Held January 11-15, 2016, at the Renaissance Arlington Capital View Hotel in Arlington, Virginia. The event included five symposia, a forum, a workshop, a CEO summit and three keynotes; 125 speakers delivering over 70 presentations; and the chance to select from up to 41.25 continuing education credits. Fifteen committee and council meetings; a joint council and committee brainstorming session; and multiple networking events gave attendees ample opportunities to catch up on projects and share ideas. Two award ceremonies highlighted industry advances and leadership while 22 exhibitors showed off the latest industry advancements on the exhibit floor.

On Monday, January 11, university decision-makers and other experts in education convened to explore curriculum to train the next generation of industry professionals at the Second Annual Conference for Higher Education. The event, which was co-hosted by the National Institute of Building Sciences and the National Association of College and Professional Athletics Facility Directors, gave Building Innovation 2016 an overall rating of 8 out of 10 and included five symposiums. Along with five symposia, there was a panel discussion where attendees could get a closer look at what impediments the building industry faces to achieving high-performance goals.

On Tuesday, January 12, the Conference wrapped up on Friday, January 15, with the Plenary Symposium: Realizing Resilience: Incentives for Owners and Operators. During the event, the Institute recognized new and retiring Board members, and for the first time the Institute recognized new and retiring Board members, and honored the 2015 award winners. In Track Two, the Security and Disaster Preparedness Symposium: Realizing Resilience: Incentives for Owners and Operators, the presenters addressed ways to encourage leaders to invest in mitigation. That evening, Institute President Henry L. Green, Hon. AIA followed up with a Report from the Cutting Edge, and talked about what projects the Institute is involved in and the next steps on the horizon for the organization.

The Conference closed with the Institute’s Board of Directors meeting, where Chairman Tim Ryan passed the gavel to newly installed Chairman Stephen T. Ayers, and welcomed new Board members.

From the completed follow-up survey, Conference attendees gave Building Innovation 2016 an overall rating of 8 out of 10 points and provided positive feedback on the quality of the programs and presenters.
Moving Forward:  
2016 Findings and Recommendations from the Consultative Council

Introduction

The design, construction, operation and regulation of buildings and infrastructure, while in the background of our lives, are the foundation of the nation’s economy. Buildings, infrastructure and the industry that supports them deliver significant benefits to the nation. They provide major contributions to the U.S. economy while protecting citizens and businesses from the impacts of natural and man-made disasters.

The National Institute of Building Sciences Consultative Council brings together U.S. building industry organizations to identify policies, practices and trends that hinder achieving the nation’s goals of high-performance buildings and communities. Each year, the Council develops a Moving Forward Report to examine some of these challenges and offer findings and recommendations on how to overcome them.

As identified in the 2014 and 2015 Moving Forward Reports, the availability of a skilled building-related workforce remains a significant challenge to the U.S. building industry. While prior reports have covered water issues, a recent increase in droughts and infrastructure issues have underscored the importance of potable water and the efficient and healthy use of this limited resource. While many of the other challenges identified in earlier reports remain and the recommendations are still relevant, the two issues of workforce and water continue to weigh heavily on the building industry, and are the primary focus of this 2016 Moving Forward Report.

Developing a Skilled Workforce

Over the past few years, almost all sectors of the building industry have reported a shortage of skilled construction workers—in multiple building disciplines and trades, and across states and regions—with a dramatic shortage in key industry trades. Surveys of the code official workforce and other building-related disciplines have revealed similar challenges. Experienced workers are retiring, leaving or have left the industry, without a sufficient number of young people in the pipeline to replace them.

The members of the Consultative Council are deeply concerned about the availability of a future workforce that can meet the goals of our respective organizations and the communities we serve. Reversing this trend requires a coordinated and collaborative effort among government, educators and industry.

A Narrow Definition of Success

As the nation continues to venture deeper into the Information Age and competes on a global stage to demonstrate technological and economic prowess, the definition of success has prioritized earning a college degree. Many high school counselors and parents consider earning a college diploma as a crucial step in a young person’s development to adulthood, regardless of the major or the high cost associated with obtaining it. Students with the aptitude and desire to enter the building industry are being directed to degrees that may not fit them.

Little attention is paid to offering support for vocational and technical schools. Where federal programs do support technical training, they often are designed around poverty alleviation, reintegration or workforce placement, not as tools to encourage high school students or current workers seeking new opportunities. Unless a family has a history in construction or related fields, parents and high school guidance counselors usually encourage students to go to college, and only recommend attending a technical training program if they lack financial means or are a mediocre student. The neglect of vocational and technical careers and job pathways—livelihoods that add value, can be quite lucrative and create highly skilled workers essential to our economy—has contributed to worker shortages.

Providing Access and Encouragement

When high schools face financial challenges, they often consider dropping vocational options, which perpetuates the lack of access and exposure. Yet, young people who get a “taste” of working with their hands through vocational or technical programs can find an unexpected, fruitful and exciting career path. High schools should offer aptitude tests as another way to mine skills in the trades.

Messaging and outreach to the public must evolve. Parents, students, educators, guidance counselors and policy makers should understand that vocational and training schools are for those who have a special aptitude.

Outreach, engagement and encouragement also must expand to include returning veterans. Many veterans have obtained highly desirable skills that would be valuable to the building industry. Veterans should receive information, support and training to enter careers within the building industry as they transition into civilian life.

An increasing number of construction and building safety jobs rely on technology and the core curriculum, such as math, science and composition. New tools, including building information modeling (BIM), virtual and augmented reality and the use of drones, offer opportunities requiring specialized knowledge.

There is a perception that the government does not need to encourage workers to enter these professions because trade unions and merit-shop-based training programs are fulfilling the need. While the network of apprenticeship and trade training programs provides skilled workers, not enough young people are entering these programs. Community college-based training programs struggle to find students. These factors contribute to a lack of direction on where workers can go for training. There are few programs that pair vocational students with mentors in the field, in part, because too few people see the critical need to fund them.

Government, education providers and the private sector must develop programs that highlight the benefits of attending vocational and technical training, and explain how training can lead to careers that provide value to society.

Roles for Government and Private Industry

Government should do more to encourage trade apprenticeships, internships and on-the-job training. The District of Columbia Department of Consumer and Regulatory Affairs, for example, offers apprenticeships for high school students. Other jurisdictions should as well. As they do for college, federal student loan programs should provide equal access for students to enter technical education programs. Efforts to reauthorize the Carl D. Perkins Career and Technical Education Act are underway. The reauthorization includes provisions to support high schools and community colleges in preparing the technical workforce.

Government and the construction industry must collaborate to help change the culture and draw more people into technical and vocational programs. They must show there is a need for skilled
construction and building officials, and demonstrate their concern and urgency by providing scholarships and other financial support. Private industry also needs to work with schools to establish technical and vocational programs that issue certifications valued by employers. These programs must be seen as worth participants’ time and money. In turn, the government should encourage the creation of industry-recognized certifications and designate their use under federal job-training and career and technical education programs.

**Engaging Women**

Outreach efforts should focus attention on letting young women know about the career opportunities in construction, design, operations, safety and assessments. While the number of women in the sector has increased over the past two decades, the industry has done little to break down barriers or address the challenges women face when entering an industry dominated by men.

The industry needs training programs and recruitment efforts targeted at women. Industries that make an effort to recruit women often find that women are eager to take on a job where they have opportunities for professional growth and can mentor other women. Those who have support from their employers and co-workers can achieve respect in their communities and in the national arena.

**Student Debt**

Students interested in fields such as architecture and engineering, which do require post-secondary education, face a different challenge: the rising burden of student debt. As the cost of education continues to increase, many graduates in these fields are choosing to leave the industry because of their debt loads rather than follow the path to professional licensure.

Government programs enable graduates in the medical, legal and veterinary professions to apply their skills in underserved areas in exchange for debt relief or repayment of their student loan balances. Similar partnerships of government and public-interest design organizations could improve community outcomes and provide experience for building industry professionals in exchange for debt relief.

**Upgrading the Current Workforce**

Technology is changing faster than any time in history. Inventors of technologies and design strategies are racing to meet today’s challenges. At the same time that the nation needs to assure the future workforce is prepared to deliver and maintain high-performance buildings and infrastructure, it is imperative that members of the existing workforce upgrade their knowledge and skills.

The current and future workforce must have the knowledge and training to effectively utilize the tools, technologies and practices that support higher levels of performance. Contractors must install and deploy new technologies correctly to realize their intended benefits. Competent building inspectors help prevent sub-standard installation of cutting-edge technologies and effective enforcement spurs industry interest in seeking technician competency. Building operators must effectively utilize building features to meet the design intent. When appraisers recognize the value of buildings that use new technologies, safety and sustainability practices, they create an incentive for other building owners to pursue these advances.

Building construction, maintenance and operation are no longer just jobs, they are professions. Not unlike other professions, they require professional development and continuing education.

**Recommendations for Advancing a Skilled Workforce**

To ensure there is a future workforce to support a high-performance built environment, the Consultative Council offers the following recommendations:

- Congress, the U.S. Department of Education (DoEd), state and local governments, schools and industry stakeholders should promote technical and trade programs in K-12 and technical schools, emphasizing career opportunities, not societal judgment. This is applicable to all genders, all races and all economic backgrounds to break down preconceived notions of who can choose to go into technical building careers.
- The U.S. Department of Defense, U.S. Department of Veterans Affairs (VA), labor unions, technical education providers, industry trade groups and veterans groups should give returning veterans information, support and training to enter the building industry as they transition into civilian life.
- The DoEd, DOE, EPA, U.S. Department of Labor (DOL) and other relevant federal agencies should, with the private sector, create a public service announcement campaign highlighting the importance of the building industry to the economy, the opportunities available and educational pathways.
- Congress and the DoEd should create opportunities for industry professionals to apply their skills in underserved communities in exchange for reductions in student debt.
- Congress and the DoEd should encourage states to develop regional and national reciprocity programs for certified trade professionals. Careers that allow geographic mobility are more attractive to people investigating career options.
- Congress, through the DoEd and DOL, should support research that quantifies the benefit of a trained building workforce to facilitate widespread certification and ongoing training, and include the benefits in legislation and budgetary actions.
- Federal agencies with building-related responsibilities, including the U.S. General Services Administration, DOE, DOD and VA, should recognize the value of certified professionals by incorporating certification requirements into procurement and contracting processes. This extends the value the federal government has shown through using updated codes for resilience. It is equally important to have qualified contractors, tradespeople, building officials and other disciplines to implement them.
- The DoEd should promote industry credentials/certifications as a viable use of federal money, such as through the Federal Perkins Loan Program (formerly known as the National Defense Student Loans) and National Direct Student Loan, to help students finance the costs of post-secondary education, and allow such funds for continuing education to maintain credentials.
- Congress and GSA should fully implement the Federal Buildings Personnel Training Act across federal agencies, which requires certification, ongoing education and training of building-related federal employees and contractors and develop criteria for contractors.

**Water Resources and the Built Environment**

Regardless of whether the nation’s homes and commercial buildings are well-designed and constructed, sustainable and energy-efficient or vital to a community or local economy, all buildings require a connection to a safe, reliable and continuous water supply to fulfill their purpose.

The federal government estimates that 40 states will experience water shortages by 2024.1 The epic drought in California and elsewhere in the West lasted for four years and the Southeast experienced a serious drought in 2016. Water scarcity is expected to result

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in billions of dollars in lost commerce. Yet, the nation’s distribution systems are failing due to decades of neglect, and drinking water that required significant energy in its treatment, pumping and distribution is leaking out before it reaches its destination. Likewise, aging wastewater systems are leaking and increasingly susceptible to failure and flooding due to strong storms, which pollute bays, rivers and lakes. 

In Flint, Michigan, the nation witnessed a tragic and cautionary example of how a community can be impacted when water safety is compromised through mismanagement, poor oversight and short-sighted cost avoidance decision-making. Lead poisoning and legionellosis outbreaks in Flint epitomize the unintended consequences that require study in order to develop and implement best practices and guidance.

A new, holistic approach to the water-use cycle must consider the sources, treatment, distribution, use and reuse of water and the better utilization of wastewater and stormwater as important resources in the water-energy nexus. Only through a strategic effort that recognizes the limited, interconnected supply of water can society address the long-term needs for this essential, finite resource while also allowing for population growth.

The Consultative Council offers this report to help policy makers foster smarter public and private-sector investments that provide long-term, sustainable solutions. New technologies, better materials and systems, smarter processes and new ideas are all part of the solution and can provide great opportunities for American businesses and workers.

**Water Distribution**

In 2013, the American Society of Civil Engineers (ASCE) gave the nation's drinking water and wastewater systems both a grade of "D" (poor) in its Report on America's Infrastructure, estimating 240,000 water main breaks per year and citing the urgent need to invest in the nation's drinking water and wastewater infrastructure. Approximately 6 billion gallons of treated water are lost each day (over 2 trillion gallons/year) due to leaks in aging and poorly managed distribution systems. The American Water Works Association's 2016 State of the Water Industry Report cites the poor condition of water and wastewater infrastructure, financing for capital improvements and the lack of public appreciation for the value of water systems and services as their members' top three concerns. These issues are complex and require leadership from all levels of government to ensure the safe use of water in buildings.

The United States has nearly 170,000 drinking water distribution systems, which complicates the ability to address these challenges. While there are fewer wastewater systems (approximately 14,780 wastewater treatment facilities and 19,739 wastewater pipe systems), the condition of many of these systems is poor, with aging pipes and inadequate capacity causing the discharge of an estimated 900 billion gallons of untreated sewage each year.

Addressing the nation’s wastewater system needs over the next 20 years will require more than $300 billion according to the Congressional Budget Office, EPA and other groups. Continuing to neglect these problems will make them more expensive to resolve.

Water utilities also are striving to meet EPAs Safe Drinking Water Act (SDWA) and Clean Water Act (CWA) requirements. The growing list of contaminants on which to report, test, monitor and eliminate from drinking water adds cost and limits funds for infrastructure projects. Yet, congressional appropriations for water projects have declined from 2008 to 2012, averaging $1.38 billion annually or $27.6 billion over 20 years—8% of EPA's estimated required investment needs.

Historically, federal funding for water-related projects has flowed through state revolving loan funds (SRFs) created for both the SDWA and CWA, funded annually by Congress. Not subsidies or grants, these funds are low-interest loans paid back by the utility system. Yet, the annual appropriations for these loans have been declining. Local water utility ratepayers bear the investment costs through increased water and wastewater rates, which are climbing faster than other utilities (such as energy and telecommunications), and the consumer price index.

EPAs efforts to provide creative funding mechanisms for utilities through SDWA and CWA SRF programs; the Water Infrastructure Finance and Innovation Act; and the Water Infrastructure and Resiliency Finance Center are laudable, but these programs need to be expanded. The federal government must expand existing financing programs to help utilities improve infrastructure while also meeting federal water quality requirements.

The case of Flint illustrates the struggles with rising costs in economically disadvantaged communities. It also highlights the need for water purveyors to carefully consider decisions that might compromise drinking water quality. Switching water sources, changing chemical disinfectant or replacing old and leaky utility pipes and water supplies can disrupt the distribution system and negatively impact water quality. Drinking water can become more corrosive due to changes in disinfectants. As a result, the protective coatings that have developed over time can dissolve, exposing old metal surfaces, resulting in dangerous lead levels. EPA, in consultation with industry experts, should develop a set of best practices to provide utilities with the precautions and preemptive steps to take prior to implementing such changes.

Due to severe and growing water scarcity, communities need to become more efficient using treated drinking water. Current water-efficiency measures must stay in place. At the same time, in addition to promoting building retrofits with the most-efficient plumbing fixtures and appliances, governments should enact policies to incentivize behavioral changes that reduce water waste and reward water-neutral development.

Smart pricing can be an effective tool to reduce water waste, particularly in landscape irrigation. Research shows that the price of water influences how water is used. As water rates skyrocket to cover infrastructure investment, the higher water prices will impact water use. The Consultative Council encourages EPA to continue its research on the impacts of higher rates on lower-income populations to ensure financially vulnerable households are not disproportionately affected.

Increasing the efficiency of water systems designed to support heavier use can have unintended and potentially dangerous consequences. As community water usage becomes more efficient, the length of time water spends in the distribution system increases—especially to buildings furthest from the point of treatment. As a result, water may reach many buildings with little residual disinfectant. This provides opportunity for legionella and other
opportunist pathogens to thrive in premise plumbing systems.\textsuperscript{10} The Center for Disease Control and Prevention (CDC) estimates between 8,000 and 18,000 annual cases of legionellosis, most resulting from water in premise plumbing systems.

The CDC recently issued guidance to building managers to prevent the spread of legionella in commercial buildings.\textsuperscript{11} While industry and public-sector experts have developed standards and guidelines to mitigate future outbreaks,\textsuperscript{12} the nation lacks a clear regulatory path to implement the new standards. No single regulatory authority has jurisdiction over all of the systems and building-based operations that need to be put into place. Thus, mandating these standards through legislation needs to be considered. Further, the required use of disinfectant injection pumps should be considered in remote portions of municipal water systems to ensure buildings in those areas have sufficient residual disinfectant in the water to mitigate growth of opportunistic pathogens. At a minimum, the SDWA should be revised to allow for the onsite treatment of water in buildings that contain at-risk populations—such as hospitals and elder care facilities—without overly burdensome water quality reporting requirements.

Finally, to ensure the delivery of safe water to newly constructed buildings in urban areas, it may not make sense to expand existing oversized water distribution systems when per-capita water use is declining. Water providers should consider developing smaller, community-based, urban water and wastewater systems serving smaller geographical areas and fewer people. The buildings in such systems can be designed from the outset to be highly water-efficient and able to utilize alternate water sources safely and effectively. Likewise, smaller, community-based, decentralized wastewater systems can be developed to take advantage of solid waste materials that can be put to beneficial use.

### Wastewater

As buildings use less water, the risk of blockages in building drains and sewers increases. There have been anecdotal reports of increased blockages in building drains, but these problems seem to be relatively rare. More commonly reported problems are sewer blockages and corrosion failures in sewer pipes due to more concentrated and acidic effluent, a direct result of less water use in buildings. As detailed in Table 1, flow rate and consumption values for plumbing fixtures, fixture fittings and water-using appliances have decreased significantly. Commercial and industrial equipment of all types are becoming more water-efficient. This overall reduction in water usage is contributing to more blockages and corrosion-related failures in sewer systems. EPA, the National Institute of Standards and Technology (NIST), wastewater treatment facilities and industry need to determine and share best practices detailing the steps utilities can take to mitigate these failures and maintain their systems as efficiently and cost-effectively as possible. Studies also need to identify the best materials to utilize for new sanitary systems and for rehabilitating existing failed sewer lines.

**Premise Plumbing**

Since 1999, Americans have reduced indoor household water use by 22% on average and per capita water use by 15%.\textsuperscript{13} These gains can be attributed to the Energy Policy Act of 1992, which regulated the consumption and flow rates of many plumbing products; utility incentives to install water-efficient products; and the 2006 creation of EPA's WaterSense voluntary labeling program.

Maximizing indoor water efficiency through regulation is approaching the practical limits. Experts fear that further reductions in indoor plumbing consumption values and flow rates would deteriorate water quality and provide minimal water conservation returns. The Plumbing Efficiency Research Coalition (PERC), an ad-hoc coalition of private-sector associations interested in plumbing and water efficiency,\textsuperscript{14} completed research in 2015 on the lower limits of toilet consumption values necessary to effectively keep building drains clear and free from chronic blockages. The study concluded that toilets consuming 1.28 gallons (4.8 liters) per flush (gpf)—formerly referred to as high-efficiency toilets—provide for adequate drainline transport, even in very-long-com

### Table 1: Water consumption by water-using plumbing products and appliances\textsuperscript{15}

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<tr>
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<tbody>
<tr>
<td>Residential Bathroom Lavatory Faucet</td>
<td>3.5+ gpm</td>
<td>2.5 gpm</td>
<td>2.2 gpm</td>
<td>2.2 gpm</td>
<td>1.5 gpm</td>
<td>57%</td>
</tr>
<tr>
<td>Showerhead</td>
<td>3.5+ gpm</td>
<td>3.5 gpm</td>
<td>2.5 gpm</td>
<td>2.5 gpm</td>
<td>2.0 gpm</td>
<td>43%</td>
</tr>
<tr>
<td>Toilet – Residential</td>
<td>5.0+ gpf</td>
<td>3.5 gpf</td>
<td>1.6 gpf</td>
<td>1.6 gpf</td>
<td>1.28 gpf</td>
<td>74%</td>
</tr>
<tr>
<td>Toilet – Commercial</td>
<td>5.0+ gpf</td>
<td>3.5 gpf</td>
<td>1.6 gpf</td>
<td>1.6 gpf</td>
<td>1.6 gpm</td>
<td>68%</td>
</tr>
<tr>
<td>Urinal</td>
<td>1.5 to 3.0+ gpf</td>
<td>1.5 to 3.0 gpf</td>
<td>1.0 gpf</td>
<td>1.0 gpf</td>
<td>0.5 gpf</td>
<td>67%</td>
</tr>
<tr>
<td>Commercial Lavatory Faucet</td>
<td>3.5+ gpm</td>
<td>2.5 gpm</td>
<td>2.2 gpm</td>
<td>0.5 gpm</td>
<td>1.3 gpm</td>
<td>86%</td>
</tr>
<tr>
<td>Food Service Pre-Rinse Spray Valve</td>
<td>5.0+ gpm</td>
<td>No requirement</td>
<td>1.6 gpm (EPA 2005)</td>
<td>No requirement</td>
<td>1.3 gpm</td>
<td>74%</td>
</tr>
<tr>
<td>Residential Clothes Washer</td>
<td>51 gallons/load</td>
<td>No requirement</td>
<td>26 gallon/load (2012 standard)</td>
<td>No requirement</td>
<td>16 gallons/load</td>
<td>67%</td>
</tr>
<tr>
<td>Residential Dishwasher</td>
<td>14 gallons/cycle</td>
<td>No requirement</td>
<td>6.5 gallons/cycle (2012 standard)</td>
<td>No requirement</td>
<td>5.0 gallons/cycle (ASHRAE S1931P)</td>
<td>64%</td>
</tr>
</tbody>
</table>

\textbf{gpm: gallons per minute}  
\textbf{gpf: gallons per flush}


\textsuperscript{14}Water Research Foundation, Residential End Uses of Water, 2016.


\textsuperscript{16}PERC consists of the Alliance for Water Efficiency (AWE), the American Society of Plumbing Engineers (ASPE), the International Association of Plumbing and Mechanical Officials (IAPMO), the International Code Council (ICC), the Plumbing-Heating-Cooling Contractors – National Association (PHICC) and Plumbing Manufacturers International (PMI)
commercial building drains where little water from other sources is available to contribute to solid waste transport. However, the study found further reducing toilet consumption would increase the risk of chronic blockages.

While many experts discourage regulatory actions to further reduce consumption and flow rates, buildings can still increase their efficiency. Research commissioned by Plumbing Manufacturers International (PMI) indicates that only 7% of installed toilets are high-efficiency. Incentive programs that promote replacing inefficient products with EPA WaterSense plumbing products and appliances continue to have great potential and will deliver significant water efficiency. Incentives to install smart metering and leak detection technologies also would make buildings more efficient without impacting the efficacy or safety of the water supply or sanitary systems.

Federal government leadership is essential to properly size water pipes in buildings. Pipe-sizing calculations are complex and must address the potential simultaneous use of all water-consuming fixtures, appliances and equipment within the building while providing residual pressure. Over-sized systems result in low water quality because of slower flows, and increase the potential for opportunistic pathogens to thrive in water pipes. Under-sized systems are noisy, can generate water hammer shock due to excessively high flow velocities, increase the potential for hot-water scalding incidents from pressure changes in the plumbing system and can cause premature system failure due to leakage and erosion corrosion. While the problem is complex, right-sized plumbing can improve water quality and increase water and energy efficiency for the life of the building without adding cost.

Dr. Roy Hunter developed the current water supply pipe-sizing methods at the National Bureau of Standards (now NIST) in the 1930s and 40s. Plumbing codes have used these methods ever since. While the industry slightly revised the calculations over the years, they remain grossly outdated and do not reflect current water use. The private sector initiated research to address this issue for residential buildings by utilizing residential water use data originally collected for a different research project. However, a similar project on non-residential buildings cannot be initiated until research is conducted and a database developed to detail how such buildings use water. The federal government should initiate research programs to better understand water use in non-residential buildings and to lead development of a modern pipe-sizing method.

By its 10-year anniversary, EPA’s WaterSense program had saved over 1.5 trillion gallons of water (equivalent to 2,271 Olympic-sized swimming pools), saved Americans more than $32.6 billion in water and energy bills, avoided the use of 212 billion kilowatt-hours of electricity and prevented 78 million metric tons of carbon dioxide emissions. Based on its effectiveness, Congress should increase funding for the WaterSense program, which currently is funded at under $2 million annually at the discretion of the EPA Administrator. (By comparison, the EnergyStar program is funded at over $40 million annually.) Without authorization by Congress, the WaterSense program is unlikely to see increased funding and risks being eliminated.

While regulatory action on indoor water use would achieve only slight gains in water efficiency, outdoor water use provides an opportunity for more substantial and safe efficiency. Outdoor water use varies greatly by region, but can account for up to 70% of residential water use in arid areas where efficiency is most needed. Construction codes and standards currently provide comprehensive water-efficiency provisions for outdoor uses of water. The federal government should offer incentives to states and local jurisdictions to adopt and enforce progressive water-efficiency codes and standards.

**Water Reuse**

One possibility to greatly reduce potable water use is the reuse of graywater and rainwater. However, water reuse must be carefully considered and adequately regulated to ensure that water reuse systems are installed and maintained properly and the water is adequately treated for its intended use.

Home and building owners are installing non-utility owned passive water reuse systems to divert rainwater and/or graywater from sanitary and storm sewers to use it for beneficial applications, such as landscape irrigation. Some Americans are treating water for toilets and clothes washers. Codes and standards developers have actively worked to provide codified installation and water-quality provisions to help ensure safe installation and use of such systems, incorporating backflow protection devices to keep potable water systems from contamination with non-potable water. However, EPA needs to provide specific, uniform water treatment and water-quality requirements for non-potable water use in buildings.

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18Currently, plumbing systems are considerably oversized. Right-sized plumbing systems will utilize smaller diameter pipes, thereby actually reducing construction costs marginally.

19The American Society of Plumbing Engineers (ASPE), the International Association of Plumbing and Mechanical Officials (IAPMO) and the Water Quality Research Foundation (WQRF) have developed an updated pipe-sizing calculation method, which is currently under review at the model plumbing code level.


21The American Society of Plumbing Engineers (ASPE), the International Association of Plumbing and Mechanical Officials (IAPMO) and the Water Quality Research Foundation (WQRF) have developed an updated pipe-sizing calculation method, which is currently under review at the model plumbing code level.

22U.S. Environmental Protection Agency WaterSense Program, 2016.
Up to 40% of residential water use and up to 90% of non-residential building water use is consumed for non-potable applications (See Figures 1 and 2). There is great potential to reduce the use of expensive, energy-laden potable water by taking advantage of non-potable water. However, research is needed to define best practices for dual-plumbing systems in buildings.

Technology will play an increasing role in addressing global water problems. There are currently prototype zero or near zero-energy, water and waste residential and commercial buildings in operation. They hold great promise in providing a blueprint for achieving water efficiency safely and reliably. To reach zero-water use, the building first must be designed to be as efficient as possible, taking advantage of high-efficiency plumbing products, appliances and irrigation equipment. Green building certification programs through third-party certification have helped to promote integrated design processes and incorporate water safety and efficiency technologies and practices.31

**Recommendations for Water Safety and Efficiency**

Addressing these challenges requires development of a strategic path forward that holistically considers how water will be used safely and efficiently. The Consultative Council’s recommendations are intended to initiate the dialogue and provide a starting point for such a strategy.

**Water and Wastewater Infrastructure:**

- Congress and EPA should expand and adequately fund SDWA and CWA SRF; the Water Infrastructure Finance and Innovation Act; and the Water Infrastructure and Resiliency Finance Center programs to help utilities improve infrastructure while also meeting federally mandated water quality requirements.
- The federal government should work with states and municipalities in a bipartisan effort to begin a dialogue with the American public about the state of water infrastructure. This dialogue should be forthright and factual to make the public aware of the severity of problems and the financial investments needed to address them.
- Federal and state government should expand the SDWA and CWA programs to allow funding of projects that address water reuse. EPA should make additional funding sources available to assist utilities in meeting future treatment requirements that arise from the SDWA and the CWA.
- The U.S. Department of Housing and Urban Development (HUD), through the Community Development Block Grant Program (CDBG), should expand its criteria and work with local officials to encourage applicants to apply for water-related upgrades and installations.
- EPA should require the use of disinfectant injector pumps to treat water delivered to buildings located furthest away from centralized water treatment facilities.
- Congress should revise the SDWA to allow treatment of water in buildings housing at-risk populations without triggering burdensome reporting requirements.
- EPA, in consultation with local governments and utilities, should conduct studies to determine the financial and environmental costs and benefits of smaller, decentralized urban water and wastewater systems.
- Congress and EPA should support research to develop best practices for utilities pertaining to changes in water treatment sources and processes and to the repair and replacement of water distribution pipes; for wastewater utilities to effectively mitigate sewer blockages; and identification of the best materials for new and rehabilitated sewer lines.

**Premise Plumbing**

- Congress should authorize and increase funding for EPA’s WaterSense program.
- NIST should reconstitute its research on premise plumbing to modernize water pipe-sizing calculations for non-residential buildings and update existing requirements.
- All levels of government should offer more financial incentives to promote the installation of high-efficiency plumbing fixtures and appliances.
- Congress should authorize DOE and EPA to provide incentives to state and local jurisdictions to adopt and enforce progressive water-efficiency codes and standards.
- State and local utility commissions should require utilities to install smart water meters that can identify leaks in buildings and provide consumers real-time water usage feedback.
- Congress should consider legislation that requires compliance with new industry standards to help mitigate outbreaks of legionellosis and other diseases caused by water-borne opportunistic pathogens in building water systems.
- The federal government should consider a moratorium on mandating further flow rate and water consumption reductions for consumer plumbing products and appliances, pending research on the effect of lower flows in water pipes on biofilm growth and the associated health and safety-related implications.

**Water Reuse**

- Congress should instruct EPA to issue uniform “fit for use” water-treatment and water-quality requirements for the various uses of non-potable water in and around buildings.
- NIST, EPA and industry stakeholders should conduct research to determine the best approach for the installation of dual plumbing systems in buildings.
- Utilities, consumers and state and local governments should support legislation mandating the installation of dual plumbing systems in areas where utilities are currently able to, or will be able to, provide recycled (reclaimed) water to buildings.
- DOE, EPA, NIST and industry stakeholders should support research on zero or near-zero-energy, water and waste for residential and commercial buildings.

**Conclusion**

As highlighted in this report, the public and private sectors can address the challenges of developing the U.S. building industry’s workforce and improving the nation’s water safety and efficiency. The building industry continues to move forward on implementing practices to achieve high-performance buildings and communities. Federal agencies and Congress are participating in the collaborative dialogue, but now is the time for action. Actionable solutions will significantly impact the nation’s ability to thrive economically and socially. Through the Consultative Council and other cross-industry groups, the building industry stands ready to create actionable policies and practices to improve the building industry workforce and the responsible use of water.

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31Third-party certification creates accountability and is incentivized by federal, state, local and private entities to help realize financial, operational and other long-term benefits. National green building programs, such as the Green Building Initiative’s Green Globes®, International Code Council’s National Green Building Standard® and U.S. Green Building Council’s LEED® programs, are examples of certification programs that encourage consideration of water safety and efficiency issues early in the design process.

NATIONAL INSTITUTE OF BUILDING SCIENCES – 2016 ANNUAL REPORT TO THE PRESIDENT OF THE UNITED STATES
## 2016 Financial Statements

### Statements of Financial Position

<table>
<thead>
<tr>
<th></th>
<th>September 30 2016</th>
<th>September 30 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ASSETS</strong></td>
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<tr>
<td><strong>CURRENT ASSETS</strong></td>
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<td>94,718</td>
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## Statements of Activities

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<thead>
<tr>
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<th>2016</th>
<th>2015</th>
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<tr>
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<td><strong>Change in Net Assets</strong></td>
<td>70,758</td>
<td>$(106,262)$</td>
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</tbody>
</table>

The accompanying notes of the Institute’s audited financial statements are an integral part of these financial statements. For a complete copy, write to: National Institute of Building Sciences, 1090 Vermont Avenue, NW, Suite 700, Washington, DC 20005-4950
The Institute Staff

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Executive Assistant to the President

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Editor/Director of Communications

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Director, Marketing & Publications

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Manager, Accounting and Network Resources

Martha A. Smith  
Administrative Services Specialist

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Project Coordinator

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Program Director

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Program Director

Richard Paradis, PE, BSCP, Bd. Cert. NCE  
Program Director

Philip Schneider, AIA  
Program Director

Stephanie Stubbs, Assoc. AIA, PMP  
Program Director

Bob Payn  
Director, Information Technology

Jiqu "JQ" Yuan, PhD, PE  
Project Manager

DeeDee Banks  
Web Production Specialist